

**American Bittern (*Botaurus lentiginosus*):  
A Technical Conservation Assessment**



**Prepared for the USDA Forest Service,  
Rocky Mountain Region,  
Species Conservation Project**

**September 6, 2006**

**David A. Wiggins, Ph.D.**  
Strix Ecological Research  
1515 Classen Drive  
Oklahoma City, OK 73106

Peer Review Administered by  
[Society for Conservation Biology](#)

Wiggins, D.A. (2006, September 6). American Bittern (*Botaurus lentiginosus*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: <http://www.fs.fed.us/r2/projects/scp/assessments/americanbittern.pdf> [date of access].

## **ACKNOWLEDGMENTS**

Rich Levad provided unpublished data on the distribution of bitterns in Colorado. Greg Hayward and Gary Patton gave many useful tips for enhancing the structure and quality of this assessment. I also thank Scott Melvin and Steve Sheffield for their careful and thorough reviews of the assessment.

## **AUTHOR'S BIOGRAPHY**

David Wiggins developed an early interest in Ornithology. During his high school years, he worked as a museum assistant under George Sutton and Gary Schnell at the University of Oklahoma. He later earned degrees from the University of Oklahoma (B.Sc. in Zoology), Brock University (M.Sc.- Parental care in Common Terns, under the supervision of Ralph Morris), and Simon Fraser University (Ph.D. – Selection on life history traits in Tree Swallows, under the supervision of Nico Verbeek). This was followed by a National Science Foundation Post-doctoral fellowship at Uppsala University in Sweden, where he studied life history evolution in Collared Flycatchers, and later a Fulbright Fellowship working on the reproductive ecology of tits (Paridae) in Namibia and Zimbabwe. He currently splits time between ecological research programs in Sweden and North America.

## **COVER PHOTO CREDIT**

American bittern (*Botaurus lentiginosus*) photographed in Lincoln County, South Dakota. ©Terry Sohl (used with permission).

## **SUMMARY OF KEY COMPONENTS FOR CONSERVATION OF THE AMERICAN BITTERN**

In the USDA Forest Service Rocky Mountain Region (Region 2), American bitterns are uncommon breeders in permanent and ephemeral wetlands, with a patchy distribution across the region. While several regional studies have suggested significant local declines in bittern numbers, the population status of bitterns is difficult to determine due to the species' secretive habits. Analysis of Breeding Bird Survey (BBS) and Christmas Bird Count data suggests that bittern populations are declining in some areas, but are apparently stable in others. Unfortunately, BBS data in Region 2 are insufficient for analysis of long-term trends, and dedicated surveying is badly needed to determine the species' population status. Surveying for American bitterns is particularly difficult as these birds are secretive and typically remain hidden in relatively inaccessible habitat. The lack of robust estimates of population density and distribution, together with a paucity of information on general breeding biology, has hampered attempts to identify population trends in this species.

The loss and degradation of freshwater, wetland habitats appears to be the biggest threat facing bittern populations. Much habitat loss has occurred because of draining seasonal and ephemeral wetlands for conversion to agricultural use (e.g., crop production, livestock grazing). In addition, wetlands are often degraded by agricultural activity (e.g., livestock grazing) on adjoining uplands. Without a large vegetative buffer, wetland value to bitterns may be decreased, and wetlands may suffer from chemical contamination due to runoff, siltation, and eutrophication. The loss of a vegetative buffer zone may lead to increased predation at bittern nests, and degradation of buffer zones may decrease foraging success and lead to site abandonment. Surveys for bitterns in Midwestern states have revealed apparently suitable habitat that was not used by breeding bitterns. This suggests that habitat degradation and/or human disturbance may be responsible for some regional declines in bittern abundance. Loss of wintering habitat (i.e., wetlands along the Gulf of Mexico coastal plain) has also been cited as a potential threat to American bitterns.

Enhancing wetland habitats and conducting research into the species' breeding biology and life history may aid the conservation of American bitterns. Currently, there is very little information available on foraging behavior, causes of variance in reproductive success, adult and juvenile survival, and habitat use during migration. In addition, further information on bittern abundance and distribution is needed. Dedicated bittern call-playback surveys appear to be the only reliable method for censusing bitterns on the breeding grounds.

With the information currently available, a region-wide conservation plan for American bitterns would ideally include:

- ◆ identification and protection of large (>3 ha, preferably >20 ha) wetlands and wetland complexes, and associated upland buffers
- ◆ management (including the restriction or elimination of livestock grazing, mowing, and burning) of grasslands in buffer zones (up to 200 m) around existing wetlands
- ◆ improvement of population inventory and monitoring techniques
- ◆ research on the factors affecting breeding success in Region 2.

# TABLE OF CONTENTS

ACKNOWLEDGMENTS .....	2
AUTHOR'S BIOGRAPHY .....	2
COVER PHOTO CREDIT .....	2
SUMMARY OF KEY COMPONENTS FOR CONSERVATION OF THE AMERICAN BITTERN .....	3
LIST OF TABLES AND FIGURES .....	5
INTRODUCTION .....	6
Goal .....	6
Scope and Limitations of Assessment.....	7
Publication of Assessment on the World Wide Web .....	7
Peer Review .....	7
MANAGEMENT STATUS AND NATURAL HISTORY .....	7
Management Status .....	7
Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies .....	7
Biology and Ecology.....	8
Systematics.....	8
Distribution and abundance.....	8
Global perspective.....	8
Regional distribution and abundance .....	11
Historical and current distribution and abundance in Region 2 .....	11
Regional discontinuities in distribution and abundance .....	13
Population trend .....	13
Activity pattern and movements .....	14
Habitat .....	15
Nesting habitat.....	15
Foraging habitat.....	15
Food and feeding habits .....	17
Breeding biology .....	17
Courtship and pair formation.....	17
Nest-site selection.....	17
Clutch and brood size .....	17
Parental care and offspring behavior .....	17
Timing of breeding and breeding success .....	17
Demography .....	17
Genetic characteristics and concerns.....	17
Life history characteristics .....	18
Social patterns and spacing .....	18
Factors limiting population growth .....	18
Community ecology .....	18
CONSERVATION.....	20
Threats.....	20
Conservation Status of the American Bittern in Region 2 .....	21
Management of the American Bittern in Region 2 .....	21
Implications and potential conservation elements .....	21
Tools and practices .....	22
Habitat management.....	22
Inventory and monitoring.....	23
Information Needs.....	23
REFERENCES .....	25

EDITORS: Gary Patton and Richard Vacirca, USDA Forest Service, Rocky Mountain Region

## LIST OF TABLES AND FIGURES

### Tables:

Table 1. Trends in abundance of American bitterns during North American Breeding Bird Surveys.....	13
Table 2. Proposed American bittern management recommendations. ....	23
Table 3. A summary of proposed American bittern survey techniques.....	23

### Figures:

Figure 1. Map of national forests and grasslands within USDA Forest Service Region 2. ....	6
Figure 2. Status of American bitterns in North America based on the Natural Heritage Program database. ...	8
Figure 3. Breeding range of American bitterns in North America.....	9
Figure 4. Winter distribution of American bitterns, based on North American Christmas Bird Count data. 10	
Figure 5. Mean number of American bitterns observed on Breeding Bird Surveys from 1982 to 2003 and percent change per year during the same period.....	12
Figure 6. Decline in the mean number of American bitterns seen on Christmas Bird Counts within the United States from 1960 to 2003. ....	14
Figure 7. Modeled potentially suitable habitat for American bitterns in Wyoming and Colorado, based on GAP analysis.....	16
Figure 8. Envirogram representing the web of linkages between American bitterns and the ecosystem in which they occur. ....	19

## INTRODUCTION

This conservation assessment is one of many being produced to support the Species Conservation Project of the USDA Forest Service (USFS), Rocky Mountain Region (Region 2). The American bittern is the focus of an assessment because it has been designated a sensitive species within Region 2 (**Figure 1**). Within the National Forest System, a sensitive species is a plant or animal whose population viability is identified as a concern by a Regional Forester because of significant current or predicted downward trends in abundance or because of significant current or predicted downward trends in habitat capability that would reduce its distribution [FSM 2670.5 (19)]. A sensitive species may require special management, so knowledge of its biology and ecology is crucial. This assessment addresses the biology, ecology, and conservation/management of the American bittern throughout its range, but with an emphasis on Region 2. This introduction defines the goal of the assessment, outlines its scope, and describes the process used in its production.

## Goal

Species conservation assessments produced as part of the Species Conservation Project are designed to provide land managers, biologists, and the public with a thorough discussion of the biology, ecology, and conservation of certain species based on current scientific knowledge. The assessment goals limit the scope of work to critical summaries of scientific knowledge, discussion of broad implications of that knowledge, and outlines of information needs. The assessment does not seek to prescribe management for the USFS. Rather, it provides the ecological background upon which management must be based, focuses on the consequences of changes in the environment that result from management (i.e., management implications), and explores management options. The assessment also discusses management approaches proposed or implemented elsewhere.

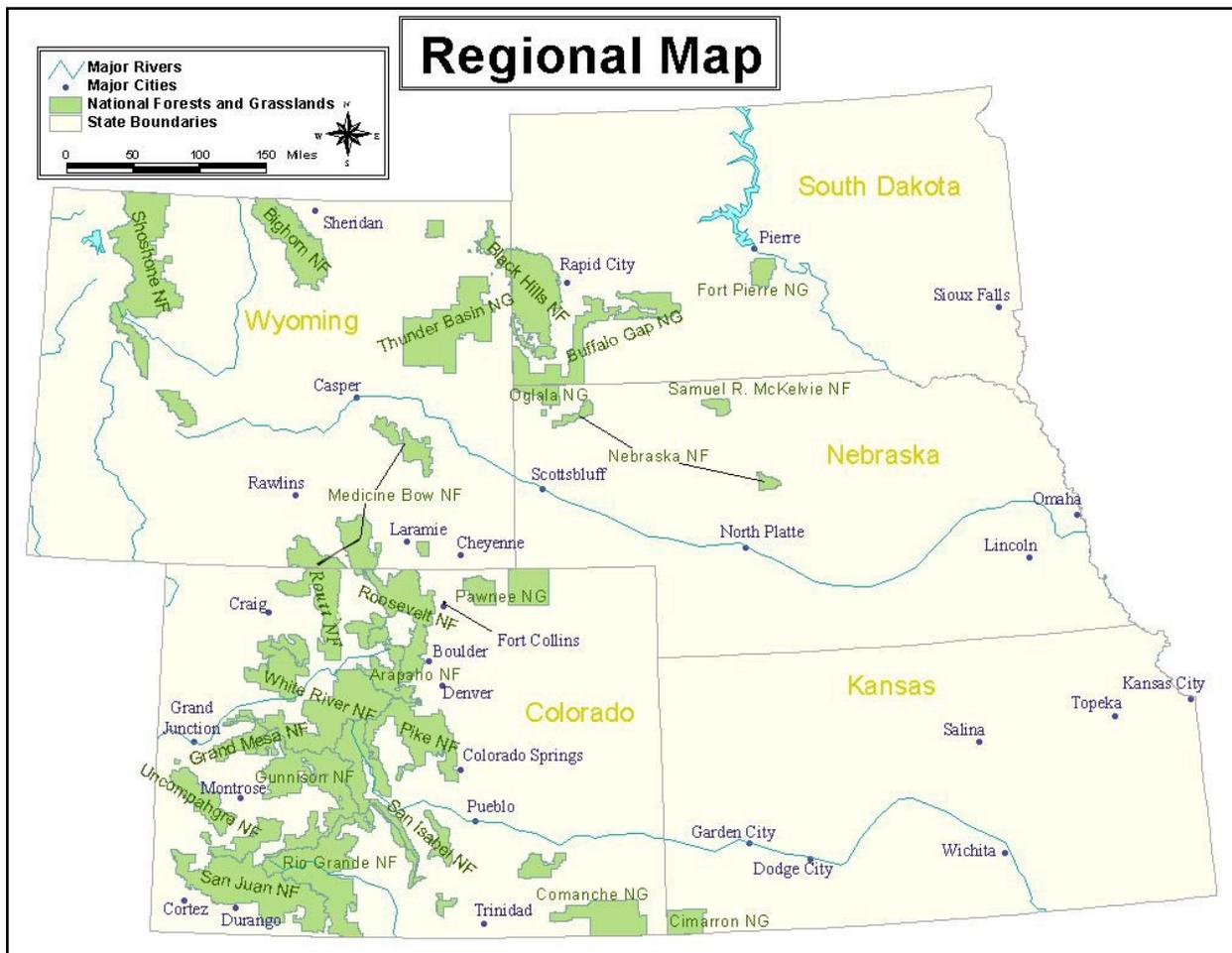


Figure 1. Map of national forests and grasslands within USDA Forest Service Region 2.

## ***Scope and Limitations of Assessment***

This assessment examines the biology, ecology, conservation, and management of the American bittern, with specific reference to the geographic and ecological characteristics of the Rocky Mountain Region. This assessment was constructed from the available American bittern literature, most of which comes from studies in the upper Midwestern states in the United States. Bittern populations on the Great Plains and in the Rocky Mountains have been poorly studied. Consequently, although much of the information in this assessment pertains to populations outside of Region 2, to the extent possible, I have attempted to place that literature in the ecological and social (e.g., land-use) context of the central and southern Rocky Mountains, and I have attempted to stress the probable differences between regional populations.

Similarly, this assessment is concerned with characteristics of American bitterns in the context of the current environment. The evolutionary environment of the species is considered in conducting the synthesis, but placed in current context.

In producing the assessment, I reviewed refereed literature, non-refereed publications, research reports, and data accumulated by resource management agencies. Not all publications on American bitterns are referenced in the assessment, nor were all published materials considered equally reliable. The assessment emphasizes refereed literature because this is the accepted standard in science. Non-refereed publications or reports were used when refereed information was unavailable, but they were regarded with greater skepticism.

## ***Publication of Assessment on the World Wide Web***

To facilitate use of species conservation assessments, they are being published on the Region 2 World Wide Web site (<http://www.fs.fed.us/r2/projects/scp>). Placing the documents on the Web makes them available to agency managers and biologists, and the public more rapidly than publishing them as reports. More importantly, Web publication will facilitate updating and revising the assessments, which will be accomplished based on protocols established by Region 2.

## ***Peer Review***

In keeping with the standards of scientific publication, assessments developed for the Species

Conservation Project have been externally peer reviewed prior to their release on the Web. This assessment was reviewed through a process administered by the Society for Conservation Biology, which chose two recognized experts (on this or related taxa) to provide critical input on the manuscript.

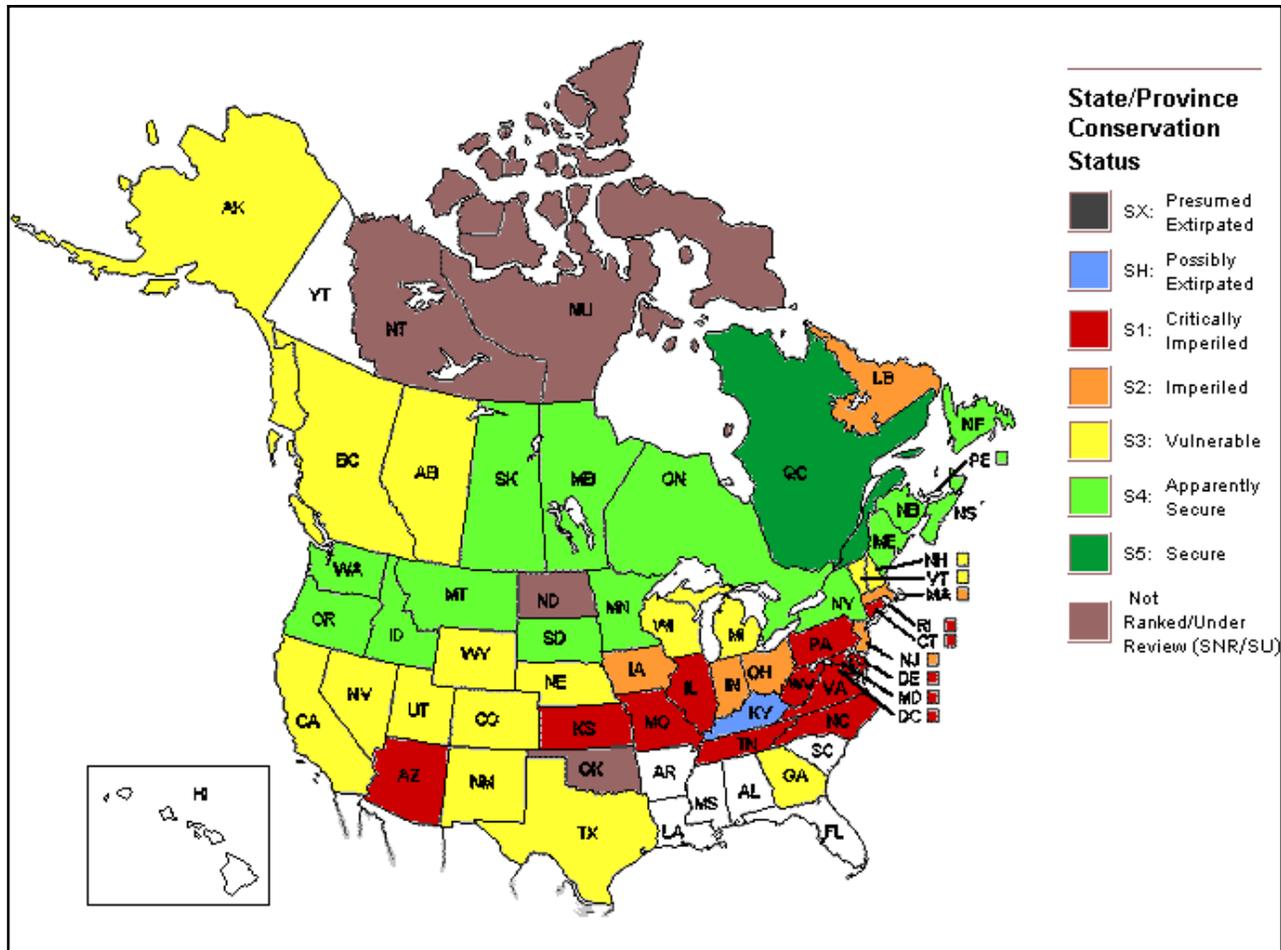
## **MANAGEMENT STATUS AND NATURAL HISTORY**

### ***Management Status***

In Canada, the American bittern is not considered a threatened or endangered species (COSEWIC 2001), but in 2006, the U.S. Fish and Wildlife Service classified it as a species of high concern in North America (<http://www.fws.gov/birds/waterbirds/statusassessment/assessment.html>). USFS Region 2 lists the American bittern as a sensitive species, but it is not listed on the Wyoming (Bureau of Land Management 2001) or Colorado (Bureau of Land Management 2000) Bureau of Land Management State Director's Sensitive Species lists. The American bittern is not listed as a Priority Species in the Colorado (Beidleman 2000) or Wyoming (Cervoski et al. 2001) Partners in Flight (PIF) state bird plans; state PIF plans for other states within Region 2 have not been published. However, it is listed as a Priority Species in the surrounding states of Montana (Casey 2000), Idaho (Ritter 2000), and New Mexico (Rustay 2001). State Natural Heritage Program rankings for this species are depicted in **Figure 2**. Within Region 2, the American bittern is listed as critically imperiled (S1) in Kansas, vulnerable (S3) in Colorado, Nebraska and Wyoming, and apparently secure (S4) in South Dakota.

### ***Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies***

The American bittern is a protected species under the federal Migratory Bird Treaty Act (16 U.S.C. 703-712), which prohibits "take" of migratory birds. While there are various general habitat protection mechanisms available (e.g., Wetland Reserve Program), these are not aimed specifically at bitterns. The only existing management plan for the American bittern concentrated on the declining populations in the Great Lakes region (Hands et al. 1989). As noted therein, one of the major problems faced in formulating a bittern management plan is the general lack of information on the species' ecology, population status, and habitat use. American bitterns have received relatively little attention from researchers, and much of their ecology



**Figure 2.** Status of American bitterns in North America based on the Natural Heritage Program database (NatureServe Explorer 2006).

and life history remain unknown (see Information Needs section below).

Currently, the best conservation strategy for American bitterns in Region 2 is indirect, in the form of regional wetland habitat conservation undertaken by the Prairie Pothole and Playa Lakes Joint Ventures. These programs are aimed (primarily) at identifying wetland habitats and securing their protection and improvement. Such programs provide for the protection of breeding and migration habitat for a host of wetland and grassland species, including the American bittern.

### ***Biology and Ecology***

#### *Systematics*

The American bittern is considered a monotypic species (American Ornithologists' Union 1957). Similarities in appearance and DNA characteristics suggest that it may form a superspecies with the South

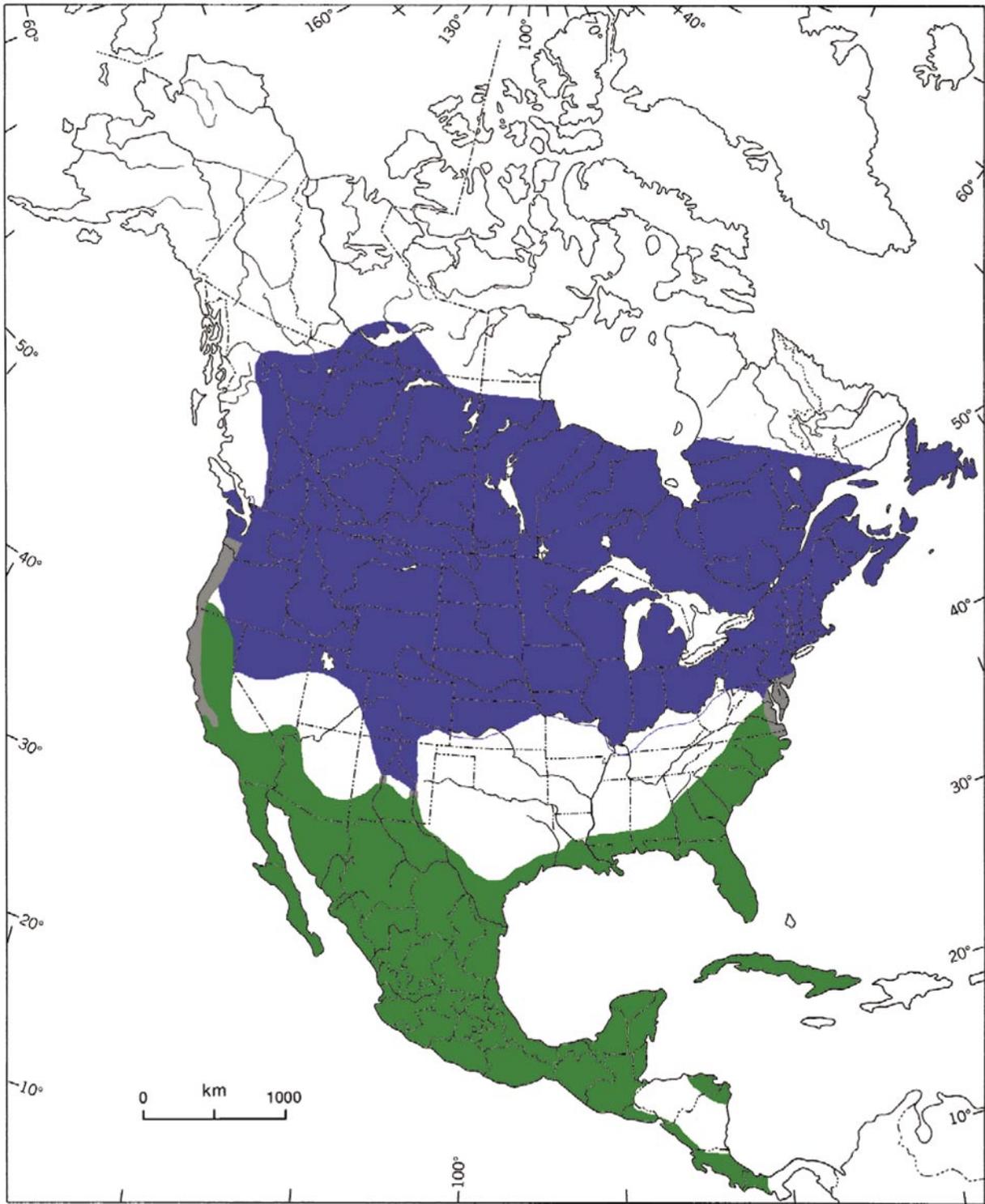
American bittern (*Botaurus pinnatus*; Sibley and Monroe 1990).

Nominate race: *Botaurus lentiginosus* Rackett.

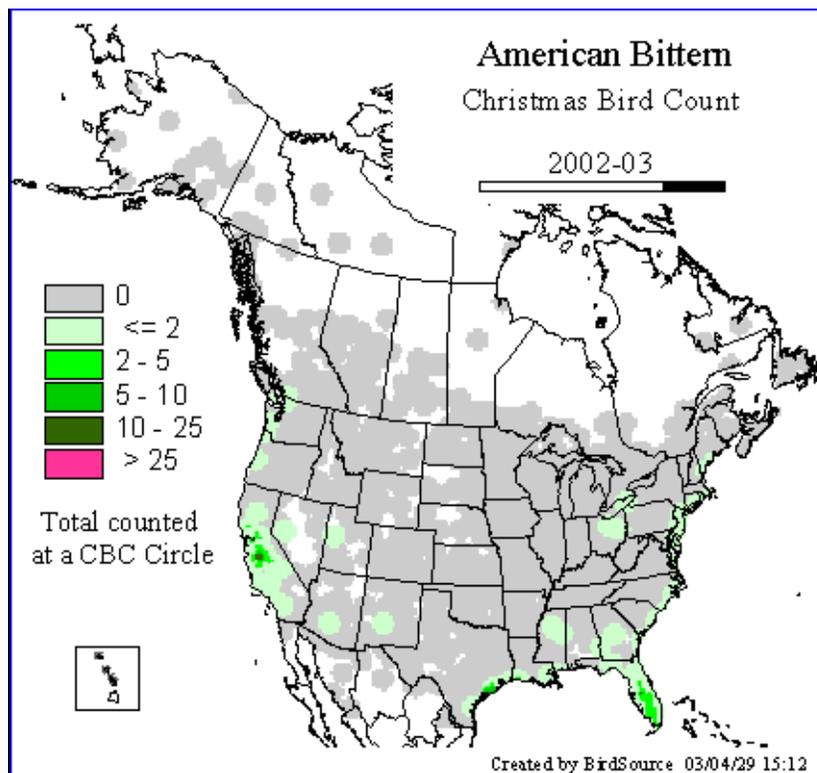
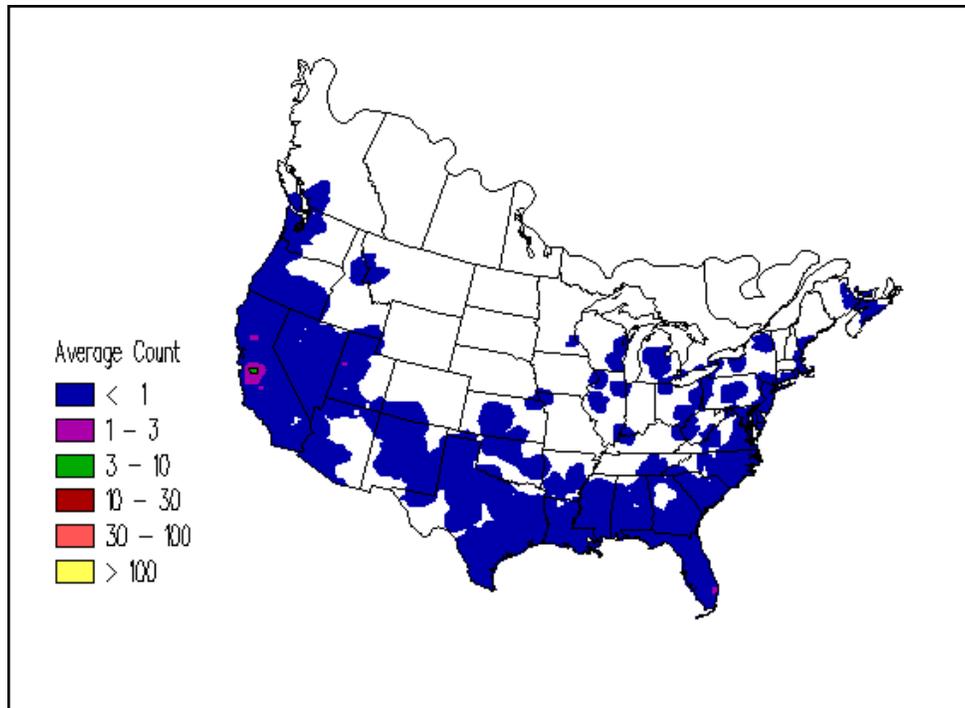
Distribution and abundance

#### *Global perspective*

American bitterns breed throughout southern and central Canada, the northern United States, south into central California and New Mexico (**Figure 3**). They winter in the southern United States, chiefly in marshes along the Gulf of Mexico coastal plain, and south into Central America (to Panama), Cuba, and the Greater Antilles (**Figure 4**). Areas of particular importance to the United States wintering population include Everglades National Park, Okefenokee Swamp, swamps/wetlands along the Mississippi and Louisiana coasts, and the Salton Sea National Wildlife Refuge (NWR) in southern California. On both summer and



**Figure 3.** Breeding range of American bitterns in North America. Figure is modified from Gibbs et al. (1992).



**Figure 4.** Winter distribution of American bitterns, based on North American Christmas Bird Count (CBC) data. The upper figure represents the average number of bitterns counted on CBCs for the period 1966-1996; the lower figure represents data from 2002-2003. Data are from the National Audubon Society (2004).

winter ranges, bitterns are very patchily distributed, apparently rarely straying far from areas of dense vegetation around permanent sources of water.

### *Regional distribution and abundance*

Most historical works suggest that American bitterns were uncommon to common breeding birds within and near Region 2 (e.g., Knight 1902, Sclater 1912). The situation has apparently changed, as most recent reports suggest that bitterns are now uncommon within the region. Although the overall distribution does not appear to have changed to a great extent, bittern breeding populations now tend to be disjunct and isolated in the southern half of Region 2. However, bittern population status is difficult to track due to the species' secretive behavior. The best range-wide source of data on population levels, the Breeding Bird Survey, is not particularly well-suited to bitterns since survey routes may not cover the specialized and relatively rare habitat favored by this species, and detection rates during 3-minute sampling periods are likely low.

The current distribution of bitterns suggests that in Kansas and Colorado, bitterns are largely restricted to large, protected lakes, reservoirs, and other wetlands with emergent vegetation. Most such areas are currently in national wildlife refuges and wildlife management areas (e.g., Yaeger 1998, Busby and Zimmerman 2001). Further north in Nebraska and South Dakota, bitterns are more widely distributed, with many occurring on wetlands located on private land (Molhoff 2001, Tallman et al. 2002). This pattern is partly the result of wetlands being more prevalent and permanent on the northern Great Plains. In western Kansas and eastern Colorado, many wetlands are in the form of playas, which are largely ephemeral and dependent on local rainfall. The status of American bitterns in playas should be monitored because there is currently very little information on the use of such sites by breeding and migrating bitterns.

See **Figure 5** for a map of the breeding density (from 1982 to 1996) in Region 2 (and North America), based on BBS abundance analyses (Sauer et al. 2003).

### *Historical and current distribution and abundance in Region 2*

**South Dakota:** Although American bitterns are thought to breed widely in South Dakota, primarily in low elevation sloughs and marshes, recent atlas work in the state documented only two confirmed nests (Peterson 1995). Nonetheless, the species was

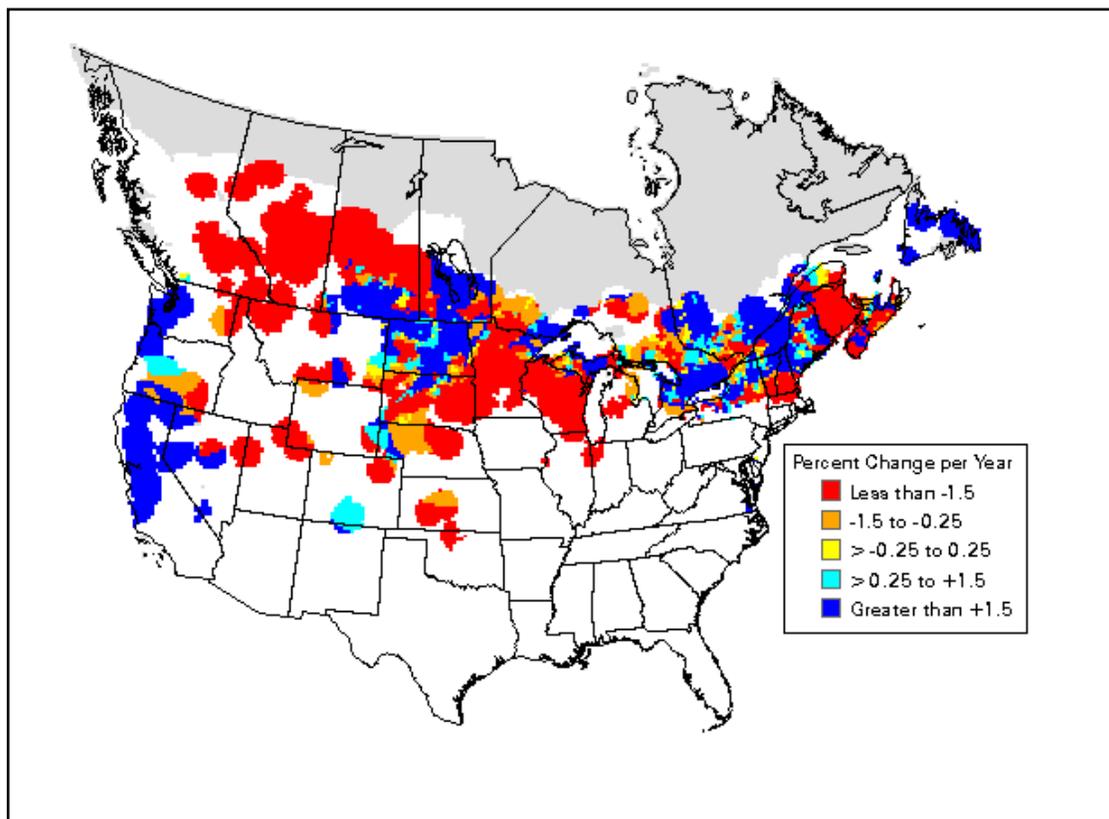
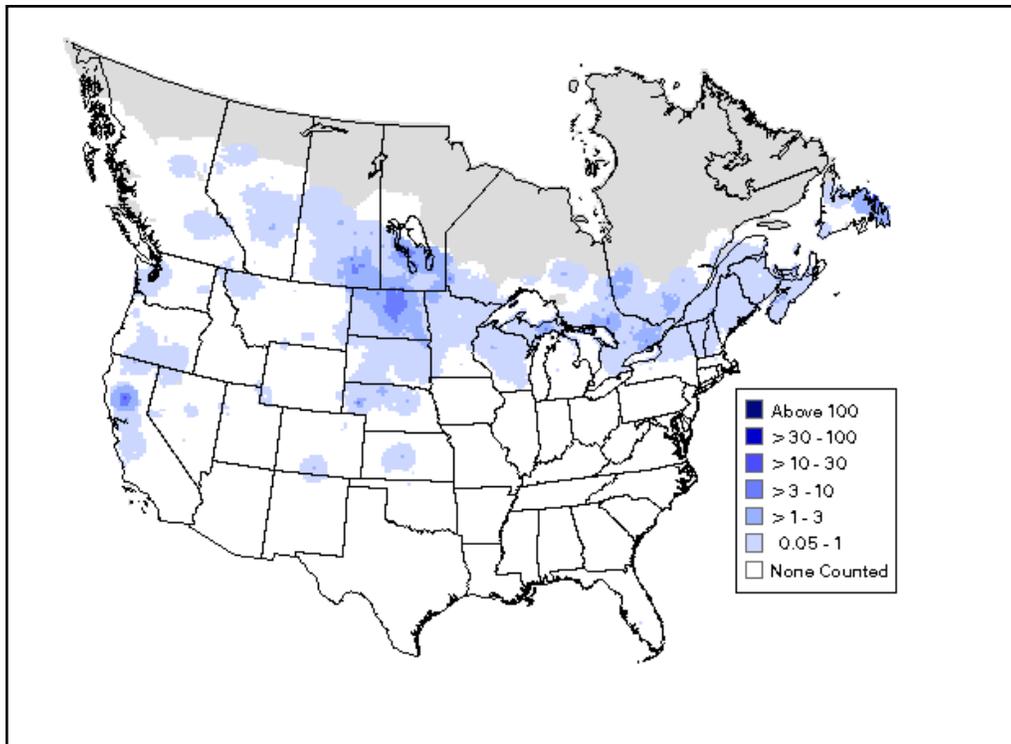
recorded almost statewide (but most commonly in the northeast, at the edge of the Prairie-Pothole region), and because of its secretive habits, many of these sightings were presumed to represent breeding birds. Tallman et al. (2002) classified American bitterns as uncommon summer residents in the eastern half of the state, and rare in the west. There are few historical references, but Over and Thoms (1921) considered American bitterns a very common summer resident, especially in sloughs in the eastern part of the state.

**Wyoming:** American bitterns are currently considered rare (Dorn and Dorn 1999) to uncommon (Scott 1994) breeders in Wyoming. As is the case in nearby states, there are widespread summer records at apparently suitable marshy areas, but comparatively few confirmed breeding records. Findholt (1984) cited nesting records for Platte, Uinta, Lincoln, and Fremont counties. Cervoski et al. (2004) reported widespread occurrence and confirmed breeding in six of 28 latilongs in the state. The species was apparently more common historically; Knight (1902) classified it as a "common summer resident."

**Nebraska:** There are recent breeding records of American bitterns throughout the eastern two-thirds of the state, but the species is generally uncommon in the western half of the state and apparently absent in the panhandle region (Molhoff 2001, Sharpe et al. 2001). While Ducey (2000) noted that most historical (1800's) records were from marshes along the Missouri River, few bitterns were found breeding in that area during recent atlas work (Molhoff 2001).

**Colorado:** In Colorado, American bitterns were historically noted as "fairly common," occurring primarily on the eastern plains and in mountain wetlands (Sclater 1912). Bailey and Niedrach (1965) suggested that it was a common summer resident, breeding in suitable (largely low-elevation) marsh habitats across the state. More recent authors have concluded that bitterns are less common than recorded historically. Andrews and Righter (1992) called bitterns a rare to uncommon summer resident on the eastern plains and in mountain parks, and Yaeger (1998) noted that bitterns are not currently found in all areas where they have historically nested.

**Kansas:** Goss (1886) considered American bitterns a common summer resident in Kansas, but gave no distributional details. Thompson and Ely (1992) reported that American bitterns are uncommon summer residents statewide in Kansas, but locally common at Cheyenne Bottoms Wildlife Management Area (WMA)



**Figure 5.** Mean number of American bitterns observed on Breeding Bird Surveys (BBS) from 1982 to 2003 (upper figure) and percent change per year during the same period (lower figure). Data are from the BBS website ([www.mbr-pwrc.usgs.gov/bbs/bbs.html](http://www.mbr-pwrc.usgs.gov/bbs/bbs.html)).

and at Quivira NWR in the central part of the state. During recent atlas work (Busby and Zimmerman 2001), there were only three “probable” breeding reports (including one at Quivira NWR) and only a single confirmed breeding (Cheyenne Bottoms WMA).

Within Region 2, the overall range of American bitterns does not appear to have changed, but recent fieldwork suggests that bitterns are now restricted to fewer sites within their historic range (Yaeger 1998, Busby and Zimmerman 2001, Molhoff 2001). A comparison of historical versus recent accounts (see discussion under individual states above) suggests that bittern abundance has apparently declined in every state in Region 2.

*Regional discontinuities in distribution and abundance*

Although most regional references show American bitterns breeding contiguously over most of Region 2, the actual breeding distribution in the region is very patchy. In Colorado and Kansas, bitterns are now apparently restricted to permanent, managed marshes (largely on national wildlife refuges) and remaining marshland around large, public lakes. The distribution appears less patchy to the north in Nebraska and South Dakota, where bitterns still breed on the more abundant marshlands in the central and eastern parts of those

states. Thus, the current distribution pattern mirrors the pattern of permanent wetlands in the region – such habitat is relatively rare in the southern and western states, but more common further north and to the east. The abundance of bitterns appears to follow a similar pattern; the species is generally uncommon in Kansas, Colorado, and Wyoming and comparatively common in Nebraska and South Dakota.

Population trend

Analyses of the available population trend data are problematical due to low sample sizes and consequent lack of statistical power. Consequently, it is difficult to draw a clear picture of the population trend of American bitterns in Region 2 and surrounding areas. BBS data (Sauer et al. 2003) are summarized in **Table 1**. Within Region 2, there is no suggestion of significant declines, but sample sizes are low. Earlier (1966 to 1979) data showed a significant decline in South Dakota, but that trend has apparently not continued in recent years. BBS trend analyses suggest that from 1966 to 1996, most of the areas in Region 2 experienced small increases in the number of bitterns; the exception is eastern South Dakota (**Figure 5**).

Problems associated with BBS survey methodology, small sample sizes (in the case of American bitterns), and undersampling of wetlands

**Table 1.** Trends in abundance of American bitterns during North American Breeding Bird Surveys (BBS). Data were taken from Sauer et al. (2005) and focus on USDA Forest Service Region 2 and surrounding areas. Region 2 states are in bold font. N is the number of BBS routes on which American bitterns were detected during the period indicated. Trend indicates the percentage change per year and is considered statistically significant at  $P \leq 0.05$ .

Region	1966-1979			1980-2004			1966-2004		
	N	Trend	P	N	Trend	P	N	Trend	P
<b>South Dakota</b>	11	-21.3	<u>0.01</u>	13	0.10	0.98	16	-4.4	0.28
<b>Nebraska</b>	2	-9.4	0.76	4	1.9	0.71	5	0.5	0.90
<b>Wyoming</b>	—	—	—	4	-0.9	0.69	6	5.0	0.28
<b>Colorado</b>	—	—	—	4	7.4	0.09	4	7.6	0.16
<b>Kansas</b>	—	—	—	2	-2.2	0.47	2	-1.0	0.77
North Dakota	16	2.4	0.66	30	7.3	<u>0.01</u>	34	4.1	0.12
Montana	—	—	—	3	-9.4	0.11	4	-10.0	<u>0.01</u>
Minnesota	18	-5.2	0.18	37	-7.4	<u>0.00</u>	43	-7.7	<u>0.00</u>
Alberta	10	2.5	0.81	22	-15.8	<u>0.01</u>	22	-10.9	<u>0.00</u>
Saskatchewan	18	-1.8	0.57	31	-3.6	<u>0.02</u>	41	-4.3	<u>0.00</u>
FWS Region 6	33	0.6	0.88	61	4.3	0.06	72	2.3	0.23
United States	159	-0.9	0.62	248	2.7	0.08	322	0.3	0.80
Canada	123	-2.8	0.28	245	-1.8	<u>0.02</u>	291	-2.3	<u>0.02</u>
North America	282	-2.4	0.24	439	-0.3	0.71	613	-1.6	0.06

suggest that the BBS trend results be viewed with some degree of uncertainty. A worrying trend is that bitterns have shown strong, statistically significant declines just outside Region 2 in Minnesota (- 6 percent per year since 1980) and in Alberta (-14 percent per year since 1980). Conversely, in North Dakota, bittern abundance has apparently increased since 1980. Although range-wide trends over the past 40 years are significantly negative, no statistically significant trend has been detected since 1980, with the exception of the Canadian Prairie Provinces and Minnesota. Thus, the pattern of population trends from BBS data is a mosaic, with largely stable populations within Region 2. CBC data from across the United States also show a pattern of long-term decline in the size of the wintering population of American bitterns (**Figure 6**).

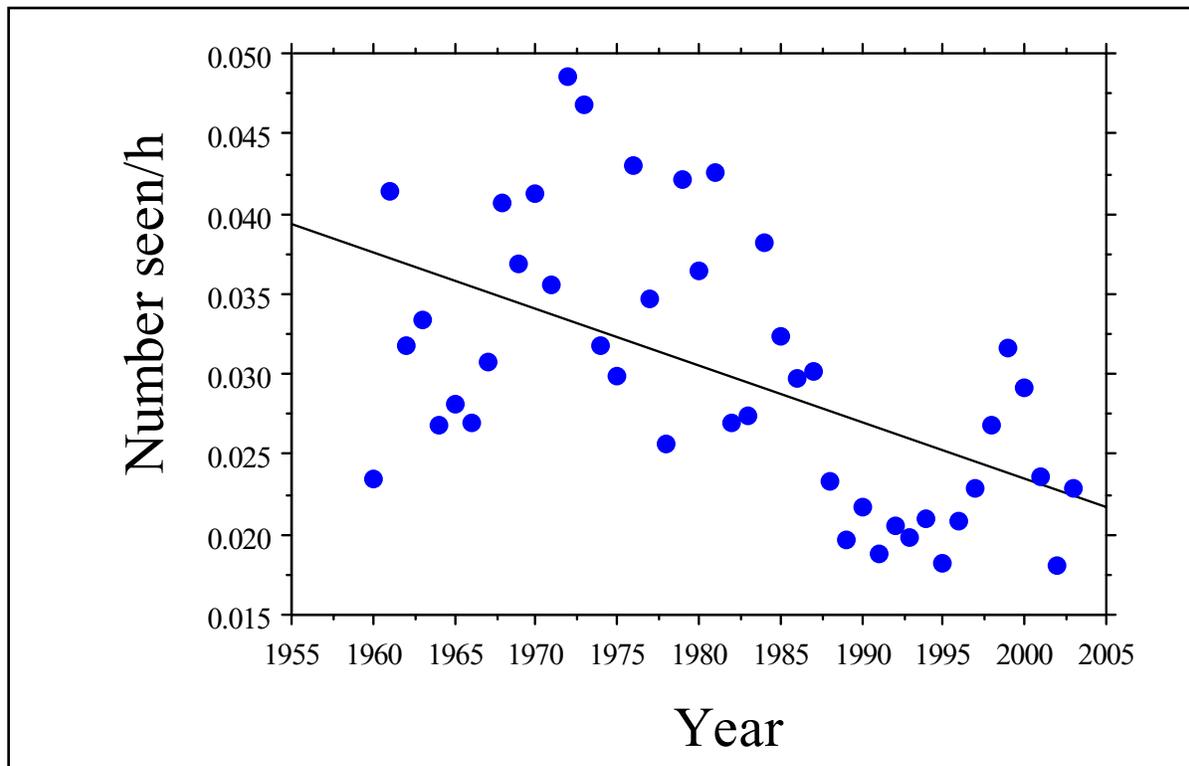
#### Activity pattern and movements

American bittern migratory behavior has received almost no study. Arrival and departure on the breeding grounds have largely been inferred from observations of birds in early spring and late fall. In Region 2, reported spring arrival and fall departure dates are generally April and May, and September and October, respectively (Andrews and Righter 1992, Thompson

and Ely 1992, Dorn and Dorn 1999, Sharpe et al. 2001, Tallman et al. 2002). However, these data must be interpreted cautiously since they do not involve marked birds, and it is therefore uncertain whether the observed birds are in fact residents, or migratory birds in passage from breeding areas further north. The extent to which American bittern populations on the Great Plains are linked is difficult to assess as there are no data on adult or juvenile philopatry, and few banding returns from which to assess dispersal (Gibbs et al. 1992).

Although there is no age-related dispersal information available on American bitterns, juvenile Eurasian bitterns (*Botaurus stellaris*) begin fall dispersal soon after fledging, with adults remaining on the breeding grounds until cold weather appears (Cramp and Simmons 1977). American bitterns may migrate in small groups, and likely do so at night (Gibbs et al. 1992).

During the breeding season, bitterns forage solitarily within dense stands of marsh vegetation (Kushlan 1978). Bitterns are highly territorial during the breeding season, and males often engage in flight chases near territorial boundaries (Gibbs et al. 1992).



**Figure 6.** Decline in the mean number of American bitterns seen on Christmas Bird Counts within the United States from 1960 to 2003. The decline ( $Y = 0.73 - 0.003X$ ,  $R^2 = 0.30$ ) was statistically significant ( $P < 0.001$ ). Data were taken from the CBC website <http://www.audubon.org/bird/cbc/hr/index.html>.

## Habitat

### *Nesting habitat*

Dechant et al. (2003) provided a comprehensive summary of American bittern nesting habitat preferences on the northern Great Plains. American bitterns typically nest in or near freshwater wetlands with tall, emergent vegetation. The critical factor associated with the choice of nesting habitat appears to be proximity to suitable foraging areas rather than the suitability of the nesting habitat per se. Consequently, bitterns may nest within emergent vegetation in wetlands and wet meadows, or in grassy, upland areas in close proximity to such wetlands (Dechant et al. 2003). The overall size of wetlands is an important feature of nesting habitat choice, as bitterns rarely breed on wetlands smaller than 3 ha (Brown and Dinsmore 1986, Daub 1993). In Minnesota, the average size of wetlands occupied by breeding bitterns was 36.7 ha (Hanowski and Niemi 1986).

American bitterns breed in and around permanent, seasonal, and restored wetlands, as well as adjoining upland habitats such as hayfields, Conservation Reserve Program (CRP) grasslands, and idle grasslands (Stewart 1975, Duebber and Lokemoen 1977, Hanowski and Niemi 1988, Gibbs et al. 1992, Dechant et al. 2003). In South Dakota, American bitterns most often nested at semi-permanent wetlands with open water surrounded by emergent vegetation (Weber et al. 1982). Naugle (1997) found that the occurrence of nesting bitterns in South Dakota semi-permanent wetlands was positively related to the percentage of wetland covered by emergent vegetation. Weber (1978) found a positive correlation between bittern occurrence and the area of adjacent idle grassland in South Dakota. Johnson (cited in Dechant et al. 2003) studied bittern use of wetlands in North and South Dakota and found a preference for seasonal and semi-permanent wetlands, especially those that were part of a wetland mosaic. The two American bittern nests found during the South Dakota breeding bird atlas project (1988 to 1993) were both in cattail (*Typha*) marshes, as were the majority of bittern sightings during the atlas period (Peterson 1995). In Nebraska, American bitterns were found nesting in wetlands dominated by cattails and bullrush (*Schoenoplectus*), as well as in upland habitats near open water (Molhoff 2001).

Potentially suitable habitat in Wyoming and Colorado, based on GAP models, is presented in **Figure 7**. These models use known habitat affinities (e.g., Dechant et al. 2003) to map potential distribution based on digital vegetation data. In Colorado, potential breeding habitat largely mirrors areas with standing

water whereas in Wyoming, upland grasslands (e.g., in southeastern Wyoming) were also included as potential breeding habitat. In this case, the map for Colorado is likely more accurate since breeding very rarely occurs away from secure water sources.

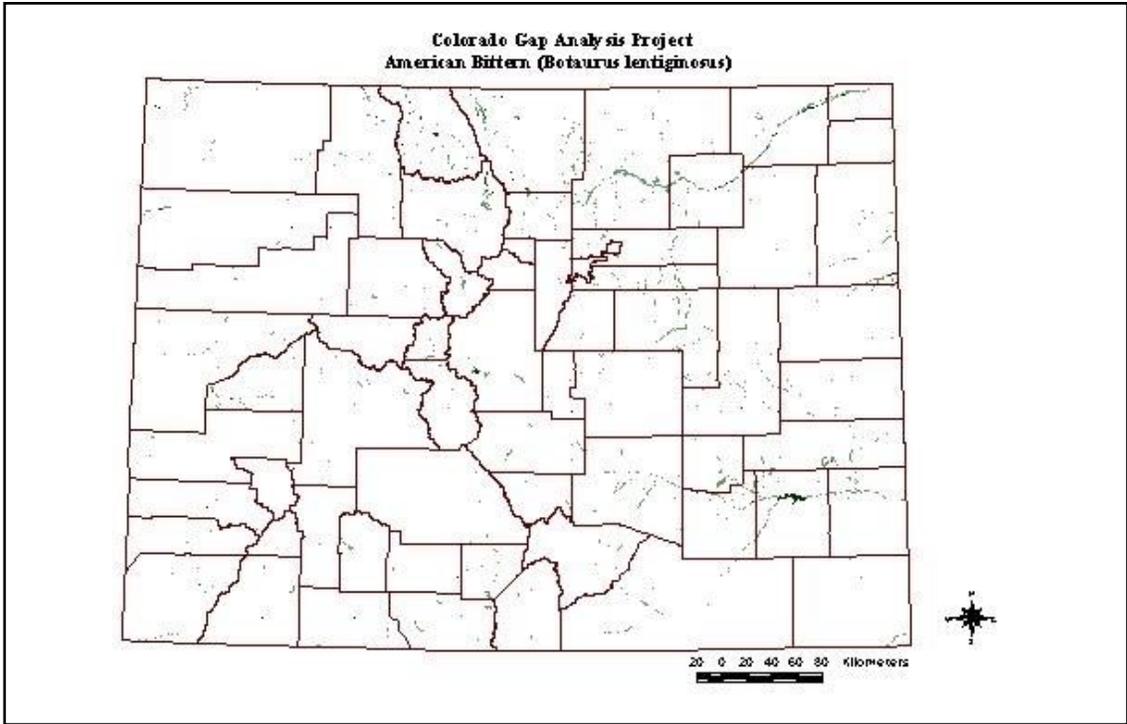
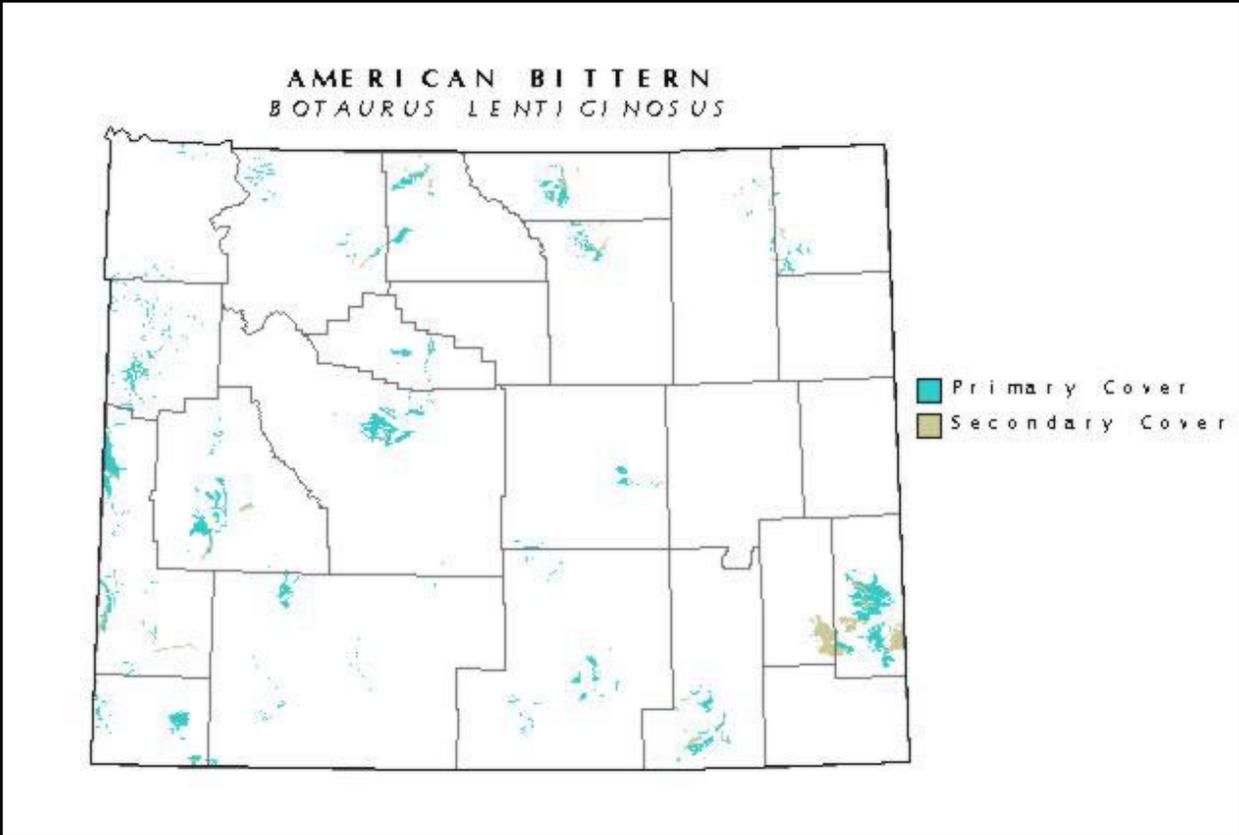
For bittern nests placed over water, preferred nest site vegetation is primarily cattails and bulrushes, but rush (*Juncus*), sedge (*Carex*), common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), and bur-reed (*Sparganium eurycarpum*) are also used (Dechant et al. 2003). At upland sites adjacent to wetlands, preferred nest site vegetation is smooth brome (*Bromus inermis*), wheatgrass (*Agropyron*), alfalfa (*Medicago sativa*), and big bluestem (*Andropogon gerardii*) (Duebber and Lokemoen 1977, Kantrud and Higgins 1992).

Two studies in Minnesota found that the average water depth around wetland nest sites was 8 to 65 cm (Brininger 1996) and 10 cm (Hanowski and Niemi 1986). Wetland nests are typically platforms built within dense emergent vegetation, 50 to 200 cm above standing water, and are composed of cattails, sedges, and other wetland vegetation.

It is not clear what factors drive bitterns to nest in upland sites instead of in emergent wetland vegetation. Likely factors include the proximity of dense, idle grasslands where nests may be well concealed, as well as the temporal stability of the local wetland. Vegetation over 60 cm high and litter cover over 50 percent characterized upland nest sites on the northern Great Plains (Dechant et al. 2003). The maximum distance from upland nest sites to nearby water appears to be approximately 100 m (Dechant et al. 2003).

### *Foraging habitat*

American bitterns are assumed to forage primarily in the emergent wetland vegetation adjacent to nest sites, but at times, they may forage hundreds of meters away from nests (S. Melvin, personal communication 2005). Foraging habitat choice has only been well quantified during migration in Missouri (Hands et al. 1989), where bitterns fed during the spring at sites with a mean water depth of 25 cm (range 12 to 35 cm), a mean vegetation height of 62 cm (range 30 to 95 cm), and a mean stem density of 14.6 stems per ft<sup>2</sup> (range 2 to 81 stems per ft<sup>2</sup>). Similar sites were used during fall migration, but mean vegetation height averaged twice as tall during this period. Bitterns typically foraged in wetlands comprised of river bulrush, bur-reed, cattail, and water smartweed (*Polygonum coccineum*).



**Figure 7.** Modeled potentially suitable habitat for American bitterns in Wyoming (upper) and Colorado (lower), based on GAP analysis.

## Food and feeding habits

American bitterns feed primarily on insects, amphibians, crayfish, small fish, and small mammals (Palmer 1962, Gibbs et al. 1992). Cottam and Uhler (1945) carried out the only quantitative study of bittern food items. Based on stomach contents of bitterns from across North America, their diet consisted of 23 percent insects, 21 percent amphibians, 21 percent fish, 19 percent crayfish, 10 percent small mammals, 5 percent snakes, and small numbers of crabs, spiders, and unidentified invertebrates. American bitterns are stealth feeders, employing only a small repertoire of feeding behavior relative to most other Ardeids (Kushlan 1978). The primary foraging technique is to stand motionless in a concealed position within stands of emergent vegetation, before striking at prey with the bill. To feed young bitterns, females typically regurgitate partially digested prey (Bent 1926, Byers 1951). Especially when the young are small, the female may regurgitate the food item repeatedly, until it is palatable to the young (Byers 1951).

## Breeding biology

### *Courtship and pair formation*

Male bitterns arrive on the breeding grounds first and begin defending territories (Palmer 1962). Pair formation apparently takes place soon after females arrive. During courtship and pair formation, males emit a low-frequency, resounding call that is described as “dunk-a-doo” or “pump-er-lunk.” Males call most frequently early in the breeding period. The extent to which calling functions in mate attraction versus territorial behavior is not known. There is no information on the length of the pair bond, and in fact, almost nothing is known of the behavior of males from the point of incubation onward (Gibbs et al. 1992).

### *Nest-site selection*

Nest site selection by American bitterns has been poorly studied, but apparently, the female chooses the site and builds the nest (Palmer 1962).

### *Clutch and brood size*

Clutch size has not often been reported for American bitterns, likely because of the difficulty in finding nests. Gibbs et al. (1992) summarized the known clutch size data and reported a range of two to seven eggs, with a mean of 3.8 for North America (n = 38; Hands et al. 1989), 3.8 in North and South Dakota (n

= 41; Duebbert and Lokemoen 1977) and 4.1 in Illinois (n = 38; Graber et al. 1977). There is no information on seasonal trends in clutch size. Young bitterns hatch asynchronously, which may facilitate more rapid dispersal of young from the nest.

### *Parental care and offspring behavior*

The female bittern incubates the eggs for 24 to 28 days (Bent 1926, Mousley 1939, Vesall 1940). Incubation typically begins the day the female lays the first egg, leading to a pronounced asynchrony in hatching dates (Mousley 1939). Only the female feeds the nestlings; males apparently make no nest visits during either the incubation or the nestling period (Vesall 1940, Gibbs et al. 1992). Nestlings are fed mainly vertebrate prey including fish, frogs, crayfish, mice, and snakes, regurgitated by the female (Gabrielson 1914, Byers 1951; see Food habits section above). Nestlings remain in the nest until they are one to two weeks old, when they typically leave the nest and hide in surrounding vegetation. At this time, they continue to be fed, but the role of the male in such feedings is unknown. Although there are no similar data available for American bitterns, Eurasian bittern young apparently fledge at 50 to 55 days of age (Cramp and Simmons 1977). There are no data available on nestling growth in American bitterns.

### *Timing of breeding and breeding success*

In Region 2 and surrounding areas, American bitterns generally begin laying eggs in May and early June, with some late clutches into July (Johnston 1965, Sutton 1967, Stewart 1975, Johnsgard 1979, Andrews and Righter 1992, Jackson et al. 1996, Tallman et al. 2002). Bitterns are apparently single-brooded (Palmer 1962), but they will re-nest if the first nesting attempt fails (Azure et al. 2000). Most nests in July are likely pairs re-nesting after initial failures. There are few data available on reproductive success. Palmer (1962) gave hatching success rates of 75 to 100 percent at four nests from different studies. At upland sites in North Dakota, Duebbert and Lokemoen (1977) reported at least one young hatching from 41 of 72 (57 percent) nests.

## Demography

### *Genetic characteristics and concerns*

American bitterns are relatively widely distributed in North America, occurring in scattered wetlands across the northern United States and southern Canada, including all of Region 2. Adult males are apparently site

faithful; Azure (1998) found that four of seven marked males returned to the breeding territory they used in the previous year. Adult females, however, apparently disperse more widely; none of the six marked females returned to breed on their previous territories (Azure 1998). Given the lack of information on natal dispersal by juvenile bitterns, it is difficult to assess what level of gene flow may be occurring at the regional scale.

#### *Life history characteristics*

American bitterns apparently lay a single clutch per year consisting of three to five eggs (range = 2 to 7; Gibbs et al. 1992). Although they are not known to double-brood, females may lay a replacement clutch if the first clutch fails (Azure et al. 2000). Individuals are thought to breed first when they are one year old, but data are needed on this point (Gibbs et al. 1992). There is scant information available on nesting success, post-fledging survival, or adult survival of American bitterns (Gibbs et al. 1992). The only data on adult survival have come from two studies in Minnesota. Brininger (1996) reported that 41 percent (9 of 22) of adults returned to breed in the year after banding, while Azure (1998) recorded 0 of 6 females and 4 of 7 males returning to their previous breeding site. There are no estimates of nestling or juvenile survival rates among American bitterns. Given the uncertainty surrounding these critical life history data, analyses of life cycle diagrams and associated demographic matrices (Caswell 1989, McDonald and Caswell 1993) were not carried out in this review. While such analyses can provide valuable insights into which life history stages may be most critical to population growth, constructing models based on incomplete and/or poor quality data may have little relevance (Reed et al. 2002).

#### *Social patterns and spacing*

American bitterns are strongly territorial. In Minnesota, home range size was measured as 127 ha (Azure 1998), and core use areas, where bitterns spend over 50 percent of their time, averaged 25 ha. Another study in Minnesota (Brininger 1996) found male and female home range sizes of 415 and 337 ha, respectively. Sociality and spacing on the wintering grounds has not been studied.

#### *Factors limiting population growth*

Extrinsic factors that may be limiting population growth of American bitterns include the loss of freshwater wetland habitat, various forms of wetland

degradation, degradation/loss of associated upland habitats, human disturbance, and increased nest predation. Outside Region 2, continuing loss of wetland habitat on the migration route and at wintering sites along the Gulf of Mexico may also pose a serious threat. In western portions of Region 2, periodic drought may threaten bittern populations by eliminating seasonal wetlands. The lack of accurate data on population trends and reproductive success makes ranking the importance of these factors difficult. In addition, accumulation of organochlorines and other chemicals in prey may depress food abundance and lead to reduced reproductive success in bitterns (see Threats section).

A factor that likely influences American bittern distribution on the Great Plains is habitat quality around wetland sites. On private land, wetland areas are often surrounded by agricultural fields with little or no natural habitat, and American bitterns tend to avoid these areas (Stewart 1975, Messmer 1985). A number of studies in North Dakota have showed that bitterns avoided nesting in upland sites (adjacent to wetlands) that had been annually burned, grazed, mowed, or tilled (Duebber and Lokemoen 1977, Messmer 1985). Thus, many wetland sites are likely unsuitable for bitterns due to land management practices on adjoining uplands. Finally, direct and indirect effects of chemical contamination on bitterns may also be limiting population growth (e.g., Causey and Graves 1969, Day and Wilson 1978).

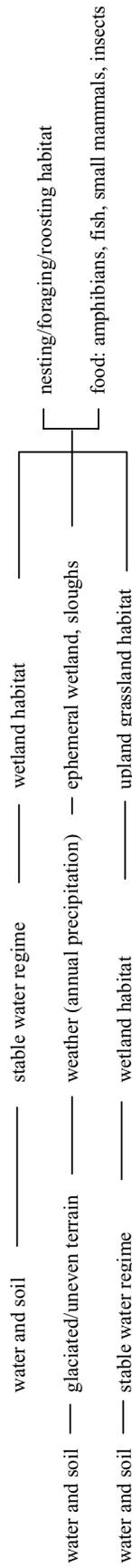
#### *Community ecology*

There is almost no information available on bittern community ecology (Gibbs et al. 1992). Predators of eggs, nestlings, and adults have not been identified. The only competitive interactions identified, between American and least bitterns (*Ixobrychus exilis*) during migration, were considered to be minimal due to differences in migration chronology, prey preferences, and body size (Hands et al. 1989). The presumed links between American bitterns and the ecosystems they occupy are displayed in an envirogram constructed for the bittern (**Figure 8**). As stated earlier, the availability and quality of habitat appear to be the primary factors affecting American bittern population viability. In Region 2, the primary factors affecting habitat quality include the loss and degradation of upland habitats adjacent to wetlands, the conversion of wetlands to agricultural use, and the potential for chemical accumulation in water and food supplies.

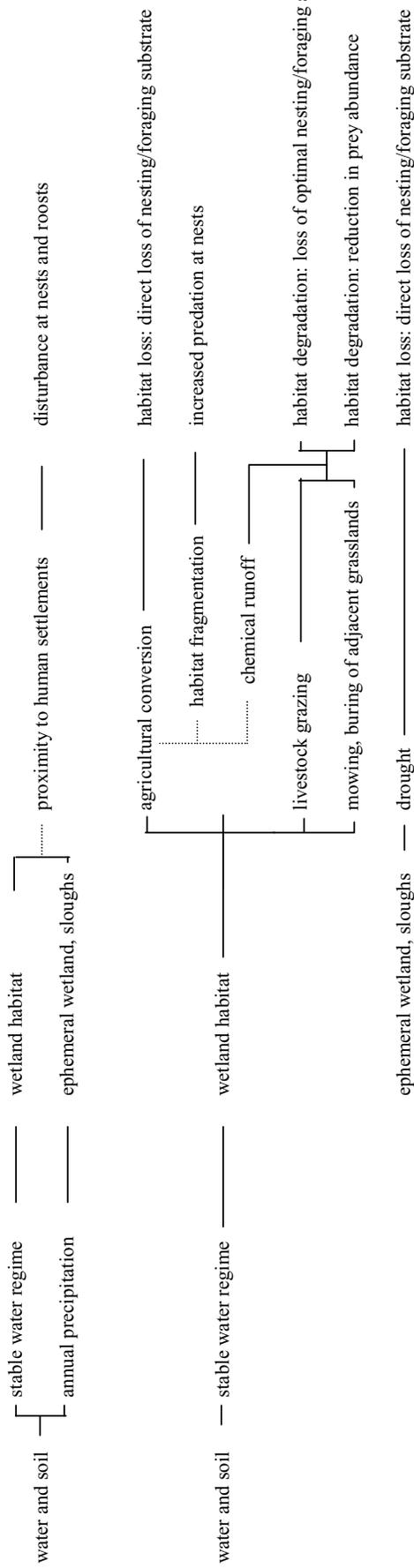
Peters (1936) reported three species of lice and one fly (Diptera) as external parasites of American

4		WEB		CENTRUM	
3		2		1	

**RESOURCES**



**MALENTITIES**



**Figure 8.** Envirogram representing the web of linkages between American bitterns and the ecosystem in which they occur.

bitterns. Endoparasites include two species of nematodes (Boyd 1966). The effects of these parasites on bitterns are unknown.

## CONSERVATION

### *Threats*

American bitterns have apparently undergone declines throughout the Great Plains, including many areas within Region 2. The primary threat to viable populations of American bitterns in Region 2 appears to be loss of breeding habitat, primarily through draining and conversion of wetlands to agricultural use. In addition, agricultural use of adjoining upland grasslands, human disturbance at breeding sites, degradation of habitat by grazing livestock, and siltation, eutrophication, and contamination of water supplies with herbicides may all be having detrimental effects on bitterns. However, due to the difficulty in assessing bittern population fluctuations in Region 2, along with a lack of information on bittern reproductive success, there are few data available with which to assess the relative importance of these potential threats. In addition, loss and degradation of wintering habitat have not been assessed.

Conversion of wetlands, especially shallow water sloughs and playas on the Great Plains, for agricultural purposes was widely carried out in the early and mid 1900's (e.g., Tiner 1984). The loss of such habitats has been cited as a major factor in the declines of waterfowl on the Great Plains, and it has likely had similar negative effects on most wetland birds, including American bitterns. Aside from the direct loss of breeding habitat, the loss of prairie sloughs and marshy areas has no doubt reduced the available migratory stop-over habitat for wetland species. It is likely that American bitterns have also been negatively affected by agricultural conversion *around* wetland sites. For example, upland grassy areas around wetlands have been shown to be important bittern nesting habitat, but such areas are often converted to agricultural use on the Great Plains (e.g., Duebbert and Lokemoen 1977, Gibbs et al. 1992).

Chemical contamination of water supplies from nearby agricultural activities may pose a significant threat to bitterns. Leeching of chemicals from nearby agricultural fields can cause eutrophication and loss of prey populations. In situations where grassland buffers have been converted to agricultural use, siltation of the water supply may also have serious long-term effects

on the quality of the wetland habitat. Such problems have been cited as factors in declines of the Eurasian bittern in England (Day and Wilson 1978). Although chemical accumulation in prey (e.g., fish, frogs) may also be occurring in such situations (e.g., Causey and Graves 1969), the extent to which American bitterns may accumulate toxins from their prey has not been investigated. However, data from California on two other Ardeid species (black-crowned night heron [*Nycticorax nycticorax*] and great egret [*Casmerodius albus*]) showed high concentrations of DDE and selenium in eggshells and a correlated reduction in eggshell thickness (Ohlendorf and Marois 1990). Organochlorine residues have also been found to accumulate in green herons (*Butorides virescens*) in the wintering range of American bitterns (Niethammer et al. 1984). Chemical contamination is clearly a potential threat to the population viability of American bitterns, but further analysis of contamination in bitterns (and their food supply) in Region 2 and on the wintering grounds is needed (see Information Needs section).

Hands et al. (1989) and Gibbs et al. (1992) both suggested that human disturbance (e.g., recreational use) at nesting areas may be having significant negative effects on American bitterns, but there is a lack of data on this potential problem. In England, disturbance by recreational boaters has been cited as a problem for bitterns (Day 1981). Hands et al. (1989) pointed out that surveys in Indiana and Minnesota often identified apparently suitable habitat with no breeding bitterns, suggesting that either food availability was poor or that human disturbance was too high.

Another potential but unmeasured problem for American bitterns is degradation of wetland habitats from livestock grazing. As freshwater areas are typically heavily utilized by grazing livestock, disturbance at nests and direct loss of habitat may both be affecting bittern reproductive success. This may be a particularly severe problem for bitterns as they may feed and nest in shoreline vegetation in and around wetlands, and such vegetation is often seriously degraded by livestock. Such problems are not restricted to private land; they may also be occurring on "protected" public lands, such as national wildlife refuges, where cattle grazing is sometimes allowed even during summer periods (D. Wiggins personal observation). Overgrazing by livestock may also negatively affect bitterns by reducing the capacity of wetland habitats to hold water and by altering flow regimes, thus degrading habitat by adversely affecting the quantity and stability of water sources.

While hunting appears to have been a serious problem for bitterns in the 1800's (e.g. Audubon 1840, Forbush 1927), today hunting is closely regulated. Nonetheless, incidental shooting of bitterns by gamebird hunters during the pursuit of other species continues today, but the extent and impact of the problem are not known (Gibbs et al. 1992).

### ***Conservation Status of the American Bittern in Region 2***

The current conservation status (i.e., population viability, threats) of American bitterns within Region 2 is difficult to assess since there have been few attempts to identify the location, density, and population trends of breeding populations. BBS data are insufficient as a monitoring tool for bitterns because the birds are secretive and difficult to detect, and their specialized habitat is inadequately sampled. The same problem exists during state breeding bird atlas studies, which often utilize a randomized blocks sampling methodology. A population monitoring scheme for American bitterns is clearly necessary in order to form a better view of their current conservation status within Region 2.

There is now a relatively large body of data from areas just outside Region 2 (e.g., North Dakota, Minnesota) that suggests that upland buffer habitat around existing wetlands is an important factor in determining habitat suitability for American bitterns. This may also be the case along migratory routes, where vegetative buffers around wetlands are often degraded by livestock grazing or converted to agricultural (e.g., row-crop) use. However, the health of wetlands may be improving due to programs aimed at improving wetland and grassland habitats on the Great Plains. These efforts include the CRP, the Wetland Reserve Program, and initiatives such as the Prairie Pothole and Playa Lakes Joint Ventures. In Region 2, the Playa Lakes Joint Venture may be of particular importance as it is providing landowner incentives for applying habitat conservation measures around wetlands.

A better picture of the conservation status of American bitterns in Region 2 will only come once the population status of the species has been more accurately resolved, and when some measure of its reproductive success can be achieved. Currently, the best available data suggest that bitterns are rare to uncommon breeders throughout Region 2, and that a loss of wetland complexes is the primary cause of the low population levels.

### ***Management of the American Bittern in Region 2***

Implications and potential conservation elements

The primary factor affecting population viability of American bitterns in Region 2 is the availability of wetland habitat for breeding. Destruction and degradation of these habitats and the continuity of complexes have a number of negative consequences for bitterns including decreased adult survival and poor reproductive success. Although recent land conservation practices such as the CRP and regional Joint Ventures (Prairie Pothole JV, Playa Lakes JV) may help to reverse such trends, no assessment of the effects of such programs has yet been carried out for American bitterns. It should also be noted that to date there has been no attempt to assess the role of wintering habitat on the population status of American bitterns.

In Region 2, the problem of habitat degradation around wetlands may be of particular importance to American bitterns, as they will nest in surrounding uplands when suitable habitat is available (e.g., Duebber and Lokemoen 1977). On the Great Plains, many wetlands are seasonal, occurring only in years of average or above-average precipitation. In such situations, the habitat immediately surrounding such sites is often under agricultural use, including livestock grazing. Aside from eliminating or degrading grassland habitat that American bitterns may otherwise use for nesting, agricultural activities near wetlands likely lead to increased runoff of chemicals and fertilizers, thus promoting eutrophication and contamination of the water supply. The lack of native habitat around wetlands may also raise predation rates at wetland nests (Daub 1993).

Because American bitterns generally require large wetlands, conservation strategies necessarily should prioritize the identification, preservation, and management of wetland complexes that include quality upland habitat surrounding and connecting wetlands. It should be noted, however, that all data on bittern home range size have come from studies north and east of Region 2, typically in relatively large wetland complexes. Therefore, it is unknown whether smaller wetlands may, under some circumstances, be utilized in drier areas (e.g., western portions of Kansas and Nebraska, eastern portions of Wyoming and Colorado), particularly during migration (see Information Needs section). On both public and private lands where

wetlands have the potential to serve as nesting habitat for American bitterns, managers should avoid activities that will degrade either wetlands or surrounding upland habitats. In particular, livestock grazing must be eliminated within these zones or managed to avoid loss of nesting cover. Human activity must also be curtailed to avoid disturbance during nesting and, perhaps, migratory stopover periods.

Currently, many of the most important known nesting areas for American bitterns in Region 2 are under some form of protection. These areas include national wildlife refuges, NFS grasslands units, and state wildlife management areas. However, many wetlands are found on private lands throughout the region, and these may be important for regional bittern breeding populations. This fact points to the need for partnerships with private landowners to help achieve conservation of wetlands and wetland complexes that can support breeding bitterns and other wetland species. Protection at such sites can be accomplished through land purchases, tax incentives, conservation easements, and enrollment of sites in programs such as the Wetland Reserve and Conservation Reserve programs. The U.S. Fish and Wildlife Service's Partners for Wildlife program provides funding and technical assistance in establishing, enhancing, or rehabilitating habitat for wildlife. Support for the habitat conservation and management programs provided by the Prairie Potholes and Playa Lakes Joint Ventures should be prioritized. Such programs seek to educate landowners and set up conservation easements and other habitat management schemes on private wetlands, and they have become increasingly oriented towards "all bird" conservation, rather than simply focusing on waterfowl. Conservation schemes directed at or including private landowners may substantially help to improve habitat conditions for American bitterns. These may include:

- ❖ Wetland Reserve Program (federal program)
- ❖ Conservation Reserve Program (federal program)
- ❖ conservation easements (federal and state programs)
- ❖ habitat management agreements (federal, state, and private programs)
- ❖ enforcement of wetland protection regulations (federal and state)

- ❖ landowner education programs (federal, state, and private programs)
- ❖ landowner tax incentive programs (largely federal programs).

#### Tools and practices

##### *Habitat management*

Management activities that apply to American bitterns in Region 2 are presented in **Table 2**. Because so little is currently known of the ecology of American bitterns in Region 2, the primary tools available to land managers relate to habitat management. American bitterns prefer relatively large (ideally >20 ha) bodies of standing water with associated aquatic vegetation such as cattails, as well as adjacent upland habitats comprised of dense, tall native or idle grassland (Weber 1978, Weber et al. 1982). Maintaining upland habitat in wide (>200 m) upland buffer zones around wetlands appears to be important for at least three reasons: 1) they are occasionally used for nesting where vegetation is tall and dense enough (Dechant et al. 2003); 2) they act as filters, thereby improving water quality and increasing food abundance in wetlands (Daub 1992, Gibbs et al. 1992); and 3) they appear to decrease nest depredation (Daub 1993). Adjacent upland habitat and vegetative buffers should not be mowed, burned, or grazed during the breeding season, nor more often than every two to five years during the non-breeding season (Duebber and Lokemoen 1977, Kantrud and Higgins 1992). Conservation agreements with private landowners should include a restriction of grazing during spring and summer periods within a 200 m buffer zone around wetlands. Grazing on the wetlands themselves should also be restricted as such activity often results in degradation of emergent vegetation.

On public land (e.g., national wildlife refuges, national grasslands), habitat management on and around wetlands (as described above in Management of the American Bittern in Region 2) should be carried out to not only benefit bitterns, but also to improve the overall health of the wetland ecosystem. As an example, in many state parks, shoreline vegetation is often burned annually in order to maintain wide areas of shoreline access for fishermen and for other human uses. In such situations, state wildlife agencies should be encouraged to work with other responsible agencies to support habitat improvements for bitterns and other wetland species.

**Table 2.** Proposed American bittern management recommendations, modified from Dechant et al. (2003).

<b>Recommendations</b>	<b>Presumed benefits</b>
Protect existing wetlands from drainage and restore former wetland sites through the use of conservation easements, management agreements, the Wetland Reserve Program, and enforcement of existing wetland protection regulations.	Increase available nesting and foraging habitat
Maintain a mosaic of large (20 to 180 ha) wetlands in different successional stages.	Provide for long-term stability of local bittern habitat
Protect wetlands from siltation, eutrophication, and chemical contamination.	Protect existing habitat quality
Maintain shallow (<61 cm) water levels throughout the breeding season.	Maintain optimal wetland habitat
Maintain a wide vegetative margin around wetlands.	Protect breeding habitat, prevents leeching and siltation, deters nest predators
Avoid haying, mowing, and grazing in areas immediately around wetlands, especially during the breeding season (April-August).	Maintain habitat suitability, decrease disturbance and increase food abundance around wetland periphery
Restrict livestock access to wetland edges.	Avoid habitat degradation and disturbance at nests

*Inventory and monitoring*

Statewide population monitoring programs (e.g., as undertaken by the Rocky Mountain Bird Observatory) should be continued as they provide a much better picture of the status and distribution of species that are difficult to track. Such programs have already provided a wealth of information on the population status of other cryptic species (e.g., black swift ) in the Region.

Surveying for American bitterns is usually accomplished through call-response to tape playbacks (e.g., Gibbs and Melvin 1993). However, there are statistical power issues that must be taken into account when designing such surveys. Gibbs and Melvin (1997) conducted call playback surveys for a variety of marsh breeding birds in Maine and found that statistical power

to detect population trends was particularly poor for American bitterns. They suggested that the problem could be overcome in part by surveying during good weather conditions and during the early breeding season, when bitterns are most vocal. Details on surveying protocols for American bitterns are summarized in **Table 3**, and further details on surveying protocols can be found online at (<http://srmwww.gov.bc.ca/risc/pubs/tebidiv/marshbirds/index.htm>) and (<http://www.waterbirdconservation.org/waterbirds/NorthAmericanMarshbirdSurveyProtocolsOnlywithoutpicture2.pdf>).

***Information Needs***

Without question, the most important information need for American bitterns is further data on the species’ general ecology in Region 2. It is important

**Table 3.** A summary of proposed American bittern survey techniques. For a full explanation of potential surveying techniques see Gibbs and Melvin (1993) and the online site: <http://www.waterbirdconservation.org/waterbirds/NorthAmericanMarshbirdSurveyProtocolsOnlywithoutpicture2.pdf>.

<b>Consideration</b>	<b>Recommendation</b>	<b>Presumed benefits/notes</b>
Survey type	Call playbacks	Measures presence-absence and relative abundance
Time of year	Early in breeding season, May-June	Highest response probability
Time of day	Dawn	Highest response probability
Weather	Low wind, no precipitation	Highest response and detection probability
Distance between survey points	400 m	Standardized continental distance
Pre-broadcast survey period	5 minutes	Provides a baseline measure of calling activity
Playback length	30 of calls, 30 silence, repeated two times	Should be standardized over the survey area

to stress that the vast majority of bittern studies come from areas to the north and east of Region 2, where wetlands tend to be more temporally stable. There is a clear need for studies within Region 2, and such studies should attempt to document the distribution and abundance of breeding American bitterns (and in the longer term, the trends in those parameters), and to identify the effects of agricultural practices (e.g., livestock grazing, CRP enrollment) on the presence and success of breeding bitterns.

Previous efforts aimed at summarizing management needs (e.g., Hands et al. 1989, Gibbs et al. 1992) have been hampered by a lack of information on bittern breeding ecology, demography, and habitat choice. Both of these studies have stressed that further data on bittern breeding ecology are needed. While some of these data (e.g., survival data, parental care patterns) will be difficult to collect, reproductive success, choice of nesting habitat, and habitat use during migration should all be possible to characterize.

The most feasible means of collecting data on breeding ecology and life history would be to monitor nests within a fairly dense population. As an example, data could be collected as a follow-up exercise to waterfowl nest dragging, which is often carried out at national wildlife refuges within Region 2. Any bittern nests discovered during nest dragging could be marked (not closer than 20 m) and checked at later intervals for reproductive success. Data on home range size and site fidelity would necessitate capturing and radio-tracking adult bitterns, a technique that has been used successfully in Minnesota (Azure 1998).

As mentioned earlier in this report, most of the data on bittern breeding ecology have come from areas to the north and east of Region 2, and largely from large wetland complexes (e.g., Agassiz National Wildlife Refuge in Minnesota). There is a clear need to gather further data on the distribution, home range size, and breeding success of bitterns on a range of wetland sizes on the central and southern Great Plains. In addition, wetland use during migration would also clarify the role of smaller sites as “stepping stone” habitat for migrating bitterns.

American bitterns should be censused across Region 2 since current population estimates (BBS, bird atlas data) are based on methodology that is not well-suited to the species. Such data would provide a baseline from which management actions could be planned. State-wide, species-specific monitoring schemes are the best methods for tracking cryptic species such as bitterns. Current surveying methodology should be tested and fine-tuned at various sites.

Finally, American bitterns are susceptible to the accumulation of potentially toxic materials (e.g., organochlorines) in their food supply. While studies from various parts of the species’ range have shown such contamination in other species of herons (with similar food habits), to date there is no information on contaminants in bitterns. Analysis of eggshell fragments from Region 2, together with analyses of food samples from the wintering range (Gulf of Mexico coastal plain) would help to clarify whether contaminant residues are posing a problem for American bitterns.

## REFERENCES

- American Ornithologists' Union. 1957. Checklist of North American Birds. Fifth edition. American Ornithologists' Union, Washington, D.C.
- Andrews, R. and R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver, CO.
- Audubon, J.J. 1840. The birds of America. (1967 reprint). Dover Publications Inc., New York, NY.
- Azure, D.A. 1998. Aspects of American Bittern ecology in northwest Minnesota. M.S. Thesis. University of North Dakota, Grand Forks, ND.
- Azure, D.A., W.L. Brininger, J.E. Toepfer, G. Huschle, and R.D. Crawford. 2000. First described renesting attempt by an American Bittern. *Wilson Bulletin* 112:271-273.
- Bailey, A.M. and R.J. Niedrach. 1965. The birds of Colorado. Denver Museum of Natural History, Denver, CO.
- Beidleman, C.A. 2000. Colorado Partners in Flight Land Bird Conservation Plan. Version 1.0. Estes Park, CO.
- Bent, A.C. 1926. Life histories of North American marsh birds. United States National Museum Bulletin no. 135, Washington, D.C.
- Boyd, E.M. 1966. Observations on nematodes of herons in North America including three new species and new host and state records. *Journal of Parasitology* 52:503-511.
- Brininger, W.L., Jr. 1996. The ecology of the American Bittern in northwest Minnesota. M.S. thesis. St. Cloud State University, St. Cloud, MN.
- Brown, M. and J.J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. *Journal of Wildlife Management* 50:392-397.
- Bureau of Land Management. 2000. Information Bulletin No. CO-2000-014. Colorado State Director's Sensitive Species List.
- Bureau of Land Management. 2001. Instruction of memorandum WY-2001-040. BLM Sensitive Species Policy and List.
- Busby, W.H. and J.L. Zimmerman. 2001. Kansas Breeding Bird Atlas. University Press of Kansas, Lawrence, KS.
- Byers, E. 1951. Feeding behavior of young American Bitterns. *Wilson Bulletin* 63:334-336.
- Casey, D. 2000. Montana Partners in Flight Bird Conservation Plan. Version 1.0. American Bird Conservancy, Kalispell, MT.
- Caswell, H. 1989. Matrix population methods. Sinauer Associates, Inc. Sunderland, MA.
- Causey, M.K. and J.B. Graves. 1969. Insecticide residues in Least Bittern eggs. *Wilson Bulletin* 81:340-341.
- Cerovski, A., M. Gorges, T. Byer, K. Duffy, and D. Felley. 2001. Wyoming Bird Conservation Plan, Version 1.0. Wyoming Partners in Flight. Wyoming Fish and Game Department, Laramie, WY.
- Cerovski, A., M. Grenier, B. Oakleaf, L. Van Fleet, and S. Patla. 2004. Atlas of Birds, Mammals, Amphibians, and Reptiles in Wyoming. Wyoming Game and Fish Department Nongame Program, Lander, WY.
- Chamberlain, T.C. 1897. The method of multiple working hypotheses. *Journal of Geology* 5:837-848.
- COSEWIC. 2001. Canadian species at risk. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario, Canada. Available online at [http://www.cosewic.gc.ca/eng/sct5/index\\_e.cfm](http://www.cosewic.gc.ca/eng/sct5/index_e.cfm).
- Cottam, C. and F.M. Uhler. 1945. Birds in relation to fishes. United States Fish and Wildlife Service Leaflet 272.
- Cramp, S. and K. Simmons. 1977. Handbook of the birds of Europe, the Middle East, and North Africa; the birds of the western Palearctic. Volume 1. Oxford University Press, Oxford, England.
- Daub, B.C. 1993. Effects of marsh area and characteristics on avian diversity and nesting success. M.S. Thesis, University of Michigan, Ann Arbor, MI.

- Day, J.C.U. 1981. Status of bitterns in Europe since 1976. *British Birds* 74:10-16.
- Day, J.C.U. and J. Wilson. 1978. Breeding bitterns in Britain. *British Birds* 71:285-300.
- Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, A.L. Zimmerman, and B.R. Euliss. 2003. Effects of management practices on grassland birds: American Bittern. Northern Prairie Wildlife Research Center, Jamestown, ND. Available online at [www.npwrc.usgs.gov/resource/literatr/grasbird/ambi/ambi.htm](http://www.npwrc.usgs.gov/resource/literatr/grasbird/ambi/ambi.htm).
- Dorn, J.L. and R.D. Dorn. 1999. *Wyoming Birds*. Second edition. Mountain West Publishing, Cheyenne, WY.
- Ducey, J.E. 2000. *Birds of the Untamed West: The History of Birdlife in Nebraska, 1750 to 1875*. Making History, Omaha, NE.
- Duebbert, H.F. and J.T. Lokemoen. 1977. Upland nesting of American Bitterns, Marsh Hawks, and Short-eared Owls. *Prairie Naturalist* 9:33-39.
- Findholt, S.L. 1984. Status and distribution of herons, egrets, ibises, and related species in Wyoming. *Colonial Waterbirds* 7:55-62.
- Forbush, E.H. 1927. *Birds of Massachusetts and other New England states*. Volume 1. Massachusetts Department of Agriculture, Boston, MA.
- Gabrielson, I.N. 1914. Ten days' bird study in a Nebraska swamp. *Wilson Bulletin* 87:51-68.
- Gibbs, J.P. and S.M. Melvin. 1993. Call-response surveys for monitoring breeding waterbirds. *Journal of Wildlife Management* 57:27-34.
- Gibbs, J.P. and S.M. Melvin. 1997. Power to detect trends in waterbird abundance with call-response surveys. *Journal of Wildlife Management* 61:1262-1267.
- Gibbs, J.P., S.M. Melvin, and F.A. Reid. 1992. American Bittern. *In*: A. Poole, P. Stettenheim, and F. Gill, editors. *The Birds of North America*, No. 18. The Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.
- Goss, N.S. 1886. *Birds of Kansas*. Kansas Publishing House, Topeka, KS.
- Graber, J.W., R.R. Graber, and E.L. Kirk. 1978. Illinois Birds: Ciconiiformes. Illinois Natural History Survey Biological Notes 109.
- Hands, H.M., R.D. Drobney, and M.R. Ryan. 1989. Status of the American bittern in the northcentral United States. Report to the U.S. Fish and Wildlife Service, Region 3 Office, Minneapolis, MN.
- Hanowski, J.M. and G.J. Niemi. 1986. Habitat characteristics for bird species of special concern. Unpublished report to Minnesota Department of Natural Resources, St. Paul, MN.
- Hanowski, J.M. and G.J. Niemi. 1988. An approach for quantifying habitat characteristics for rare wetland birds. Pages 51-56 *in* *Ecosystem management: rare and endangered species and significant habitats*. Proceedings of the 15<sup>th</sup> Annual Natural Areas Conference.
- Hillborn, R. and M. Mangel. 1997. *The ecological detective: confronting models with data*. Princeton University Press, Princeton, NJ.
- Jackson, L.S., C.A. Thompson, and J.J. Dinsmore. 1996. *The Iowa Breeding Bird Atlas*. University of Iowa Press, Iowa City, IA.
- Johnsgard, P.A. 1979. *Birds of the Great Plains*. University of Nebraska Press, Lincoln, NE.
- Johnston, R.F. 1965. *A Directory to the Birdlife of Kansas*. University of Kansas Museum of Natural History Miscellaneous Publication No. 41. Lawrence, KS.
- Kantrud, H.A. and K.F. Higgins. 1992. Nest and nest site characteristics of some ground nesting, non-passerine birds of northern grasslands. *Prairie Naturalist* 24:67-84.
- Knight, W.C. 1902. *The birds of Wyoming*. University of Wyoming Agricultural Experiment Station Bulletin Number 55, Laramie, WY.

- Kushlan, J.A. 1978. Feeding ecology of wading birds. National Audubon Society Research Report 7:249-298.
- Latta, M.J., C.J. Beardmore, and T.E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Department, Phoenix, AZ.
- McDonald, D.B. and H. Caswell. 1993. Matrix methods for avian demography. Pages 139-185 in D. Power, editor. Current Ornithology, Volume 10. Plenum Press, New York, NY.
- Melvin, S. 2005. Biologist, Massachusetts Division of Fisheries and Wildlife, Westboro, MA. Personal communication.
- Messmer, T.A. 1985. Effects of specialized grazing systems on upland nesting birds in southcentral North Dakota. M.S. Thesis. North Dakota State University, Fargo, ND.
- Molhoff, W.J. 2001. The Nebraska Breeding Bird Atlas 1984-1989. Nebraska Ornithologists' Union, Occasional Papers No. 7, Lincoln, NE.
- Mousley, H. 1939. Home life of the American Bittern. Wilson Bulletin 51:83-85.
- National Audubon Society. 2004. The Christmas Bird Count Historical Results [Online]. Available online at <http://www.audubon.org/bird/cbc>.
- NatureServe. 2003. NatureServe Explorer: An online encyclopedia of life [web application]. Version 1.8. NatureServe, Arlington, VA. Available online at [www.natureserve.org/explorer](http://www.natureserve.org/explorer) (Accessed 13 July 2003).
- Naugle, D.E. 1997. Habitat area requirements of prairie wetland birds in eastern South Dakota. Ph.D. Dissertation. South Dakota State University, Brookings, SD.
- Niethammer, K.R., D.H. White, T.S. Baskett, and M.W. Sayre. 1984. Presence and biomagnification of organochlorine chemical residues in oxbow lakes of Northeastern Louisiana. Archives of Environmental Contamination and Toxicology 13:63-74.
- Ohlendorf, H.M. and K.C. Marois. 1990. Organochlorines and selenium in California night-heron and egret eggs. Environmental Monitoring and Assessment 15:91-104.
- Over, W.H. and C.S. Thoms. 1921. The birds of South Dakota. South Dakota Geological and Natural History Survey, Bulletin 9, Vermillion, SD.
- Palmer, R.S. 1962. Handbook of North American birds, Volume 1. Yale University Press, New Haven, CT.
- Parrish, J.R., F. Howe, and R. Norvell. 2002. Utah Partners in Flight Avian Conservation Strategy. Version 2. Utah Partners in Flight Program, Utah Division of Wildlife Resources, UDWR Publication Number 02-27, Salt Lake City, UT.
- Peters, H.S. 1936. A list of external parasites from birds of the eastern part of the United States. Bird-Banding 7:9-27.
- Peterson, R.A. 1995. The South Dakota Breeding Bird Atlas. South Dakota Ornithologists' Union, Aberdeen, SD.
- Platt, J.R. 1964. Strong inference. Science 146:347-353.
- Reed, J.M., L.S. Mills, J.B. Dunning Jr., E.S. Menges, K.S. McKelvey, R. Frye, S.R. Beissinger, M-C. Anstett, and P. Miller. 2002. Emerging issues in population viability analysis. Conservation Biology 16:7-19.
- Ritter, S. 2000. Idaho Partners in Flight Bird Conservation Plan, Version 1.0. Unpublished report. Available online at [www.partnersinflight.org](http://www.partnersinflight.org).
- Rustay, C.M. 2001. New Mexico Bird Conservation Plan, Version 1.1. Hawks Aloft Inc., Albuquerque, NM.
- Sauer, J.R., J.E. Hines, and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2004. Version 2005.1, USGS Patuxent Wildlife Research Center, Laurel, MD. Available online at [www.mp2-pwrc.usgs.gov/bbs/](http://www.mp2-pwrc.usgs.gov/bbs/).
- Slater, W.L. 1912. A history of the birds of Colorado. Witherby, London, England.

- Scott, O.K. 1993. A birder's guide to Wyoming. American Birding Association, Colorado Springs, CO.
- Sharpe, R.S., W.R. Silcock, and J.G. Jorgensen. 2001. Birds of Nebraska. University of Nebraska Press, Lincoln, NE.
- Sibley, C.G. and B.L. Monroe. 1990. Distribution and taxonomy of birds of the world. Yale University Press, New Haven, CT.
- Stewart, R.E. 1975. Breeding birds of North Dakota. Tri-College Center for Environmental Studies, Fargo, ND.
- Sutton, G.M. 1967. Oklahoma Birds. University of Oklahoma Press, Norman, OK.
- Tallman, D.A., D.L. Swanson, and J.S. Palmer. 2002. Birds of South Dakota. South Dakota Ornithologists' Union, Aberdeen, SD.
- Thompson, M.C. and C. Ely. 1992. Birds in Kansas. Volume I. University of Kansas Museum of Natural History, Lawrence, KS.
- Tiner, R.W., Jr. 1984. Wetlands of the United States: current status and recent trends. United States Fish and Wildlife Service, National Wetlands Inventory, Washington, D.C.
- Tordoff, H.B. 1956. Check-list of the Birds of Kansas. University of Kansas Museum of Natural History Publications, Volume 8:307-359.
- U.S. Fish and Wildlife Service. 2003. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, VA. Available online at <http://migratorybirds.fws.gov/reports/bcc2002.pdf>.
- Vesall, D.B. 1940. Notes on nesting habits of the American Bittern. Wilson Bulletin 52:207-208.
- Weber, M.J. 1978. Non-game birds in relation to habitat variation on South Dakota wetlands. M.S. Thesis. South Dakota State University, Brookings, SD.
- Weber, M.J., P.A. Vohs, Jr., and L.D. Flake. 1982. Use of prairie wetlands by selected bird species in South Dakota. Wilson Bulletin 94:550-554.
- Yaeger, M. 1998. American Bittern. Pages 52-53 *in* H.E. Kingery, editor. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, CO.

**The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.**